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Pryeria sinica Moore (Lepidoptera, Zygaenidae), a newly discovered relic in Taiwan

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Abstract *Pryeria sinica* Moore was recently discovered from the subalpine zone of Taiwan as the first member of Zygaeninae of the island. The present paper provides taxonomic diagnosis, genitalic illustrations, biological observation and hostplant selection of this new addition. This discovery has also interesting biogeographic interpretations.

Key words Celastraceae, diurnal moths, monophagy, phenology, phylogeny.

Introduction

The monotypic genus *Pryeria* Moore, 1877 is characteristic in Zygaenidae in its transparent wings, reduced proboscis and caudal hair tufts. It had ever been associated with *Phauda* Walker, 1854 (Inoue, 1982), however, its placement to the subfamily Zygaeninae has been demonstrated and elucidated by Alberti (1954) and Naumann (1987 & 1988). The genus represents the only Celastraceae-feeder in Zygaenidae of the related areas to Taiwan, and the most primitive lineage of the subfamily Zygaeninae (Naumann, 1987). Because the distribution of *Celastrus* L. and *Euonymus* L. extends from Japan, China to Taiwan, where the Celastraceae-feeding behaviour likely evolved, it seems unusual that *Pryeria* was absent from the subalpine zone of Taiwan. As examining the Shiraki Collection in NTUIM (Insect Museum, National Taiwan University), a couple of *Pryeria sinica* collected by T. Shiraki from N. Taiwan was found. To confirm existance of this palaearctic insect, we have started to investigate around *Celastrus* and *Euonymus* shrubs on Taiwan since 1993. These efforts finally produced this new addition to the zygaenid fauna of Taiwan.

In December of 1995, the diapausing eggs were collected from *Celastrus punctatus* Thunb. at Song-Gang (Nantou), and then about 30 eggs were brought to the laboratory at low temperature (4°C). The larvae hatched in early March of 1996 and were reared in plastic cases with an abundant supply of the leaves of the hostplant ; pupae with cocoons were left in the cases to emerge. Of the same species, dried adult specimens and alcohol-preserved larval specimens deposited in many museums were examined also from Japan, Russia, Korea and China. They were illustrated and compared with Taiwanese specimens.

Depositories of materials examined. We give below a list of abbreviations of the collections in which the materials examined are preserved or will be deposited.

BMNH : The Natural History Museum, London, England.
CMNC : C.M. Naumann Collection, Wachtberg, Germany.
HUFA : Hokkaido University, Faculty of Agriculture, Sapporo, Japan.
KHCT : K. Horie Collection, Tokyo, Japan.
NSMT : National Science Museum, Tokyo, Japan.
NTUIM : Insect Museum, Department and Institute of Plant Pathology and Entomology,

National Taiwan University, Taipei, Taiwan.
SHYC : S. H. Yen Collection, Taiwan.
TLFM : Tiroler Landesmuseum Ferdinandeum, Naturwissenschaften, Innsburck, Austria.
ZFMK : Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn, Germany.
YKCT : Y. Kishida Collection, Tokyo, Japan.

Taxonomic accounts

Pryeria sinica Moore, 1877 (Figs 1–4)

Pryeria sinica Moore, 1877, *Ann. Mag. nat. Hist.* (4) **20**: 86 (China). Holotype, ♂: China, Shanghai; labelled; right antenna and left hindwing missing (BMNH) [examined].

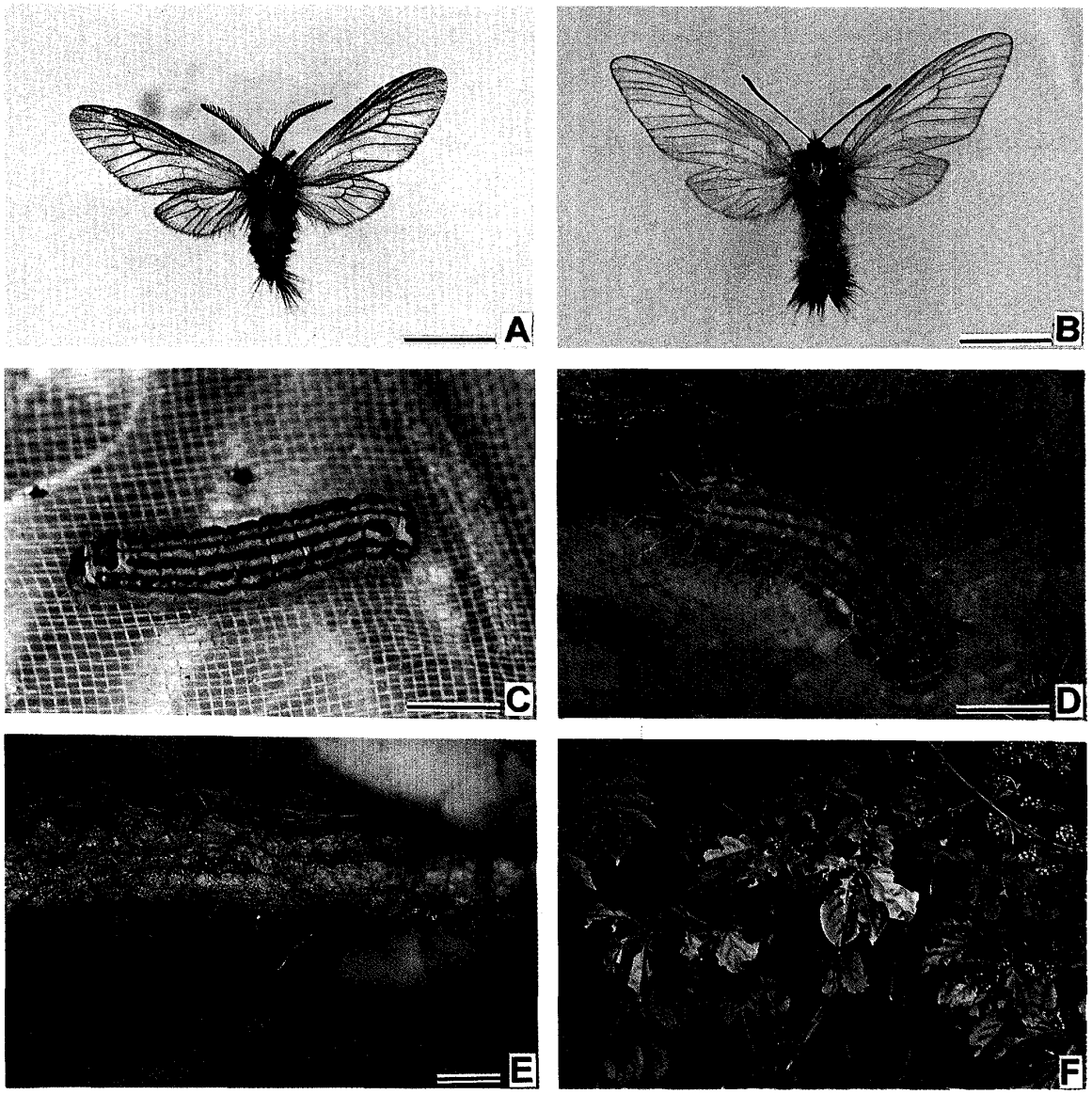

Fig. 1. *Pryeria sinica* Moore and its host plant. A. Male (Taiwan). B. Female (Taiwan). C. Mature larva (Taiwan). D. Mature larva (Japan, Nagoya). E. Egg cluster (Japan, Kyoto). F. *Celastrus punctatus* (Celastraceae) defoliated by mature larvae (Taiwan).

Neopryeria jezoensis Matsumura, 1927, *J. Coll. Agric. Hokkaido Imp. Univ.* **19**: 75, pl. 4, fig. 16 (Japan).
Holotype, ♂: Japan, Hokkaido, Sapporo, Mt Moiwa (HUFA) [examined].

Diagnosis of adult. Length of forewing: ♂, 10–13 mm; ♀, 12–14 mm. A medium-sized zygaenine moth with transparent wings, with a few scattered black scales; wings of female lighter and broader.

Male. Head: Vertex fuscous, frons concealed. Labial palpus short, with sparse short hair-like scales. Antennal length 8.5–8.7 mm, bipectinate; flagellar segments 40–42, black, 1.1–1.2 mm, with numerous acicurate sensillae trichodea. Proboscis greatly reduced. Chaetosemata restricted on vertex, sensilla acicurate with basal scales erect and curved interiorly. Thorax: Tegula and thorax black with sparse yellow hair-like scales. Forewing elongated, transparent with yellow scales expanded from base along costal margin; discoidal cell about 2/3 as long as wing length; R_2 stalked with R_3+R_5; CuA_2 emitting from discoidal cell at proximal 2/3; a cross-vein present between 1A+2A and 3A. Hindwing short, ovate with costa prominent, transparent with long black and yellow scales extending from base to hind angle; discoidal cell about 1/2 as long as wing length; cilia black; vein $Sc+R_1$ fused with Rs at proximal 1/2; a cross vein present between $Sc+R_1+R_2$ and M_1; M_3 present. Legs dark fuscous with black and yellow long hairs on femur. Abdomen: Black to golden dorsally; hair tufts arising from tergite dorsolaterally.

Female. Larger than male in size. Antenna clubbed with 40–42 segments, sensilla trichodea sparsely scattered on flagellar.

Male genitalia. Uncus stout, slightly curved dorsoventrally, apical part bifurcate with two tips rounded; gnathos arms fused medially, forming two lobes with tips rounded; tegumen broad; vinculum narrow with a prominent, well sclerotized saccus; transtilla absent; juxta orbicular, strongly sclerotized; valva rounded with apical part densely setose, costa well sclerotized; aedeagus short, stout, strongly sclerotized with 1 cornutus.

Female genitalia. Bursa copulatrix with corpus bursae stout, short, not even reaching the beginning of the sixth segment, ductus bursae not distinguishable from corpus bursae; ductus seminalis branching from lower part of ostium, entering oviductus communis next to infundibulum of receptacule complex; pseudobursa absent; receptaculum seminis with infundibulum well developed; lagena not separated from glandula receptaculis; glandula sebacea Y-shaped, reservoir absent (see Naumann, 1988).

Immature stages. Mature larva 15.0–22.0 mm in length (n=20). Head retractile, prognathous; epicranium with well-developed inverted Y-shaped suture; medial arm of suture about 1/3 of head. Ocelli six in number. Head with primary setae consisting of simple hairs; thorax and abdomen with primary and subprimary setae.

Pattern and colouration. Aposematic, with white ground colour and black spots dorsolaterally and with venter yellow. Dorsal row consisting of one or two spots per segment; two rows of subdorsal spots above level of spiracles; lateral spot below and associated with setal group L1, L2 and L3.

Chaetotaxy. Cranial setae: C1 and C2 long; F1 shorter than C1 and C2, Fa close to and mesad from F1; AF1 very short, AF2 absent; A1 long; V1 and V2 very short, Va caudad and laterad from V2, V3 absent; O1 very short, near third and fourth ocellus, O2 longer than O1 and O3; SO1 slightly shorter than SO2, near first ocellus. Thoracic and abdominal setae: Tactile setae with XD1 and XD2 primary, of approximately equal length; XD1 dorsal to XD2. D1 and D2 primary on thoracic and abdominal segments, of approximately

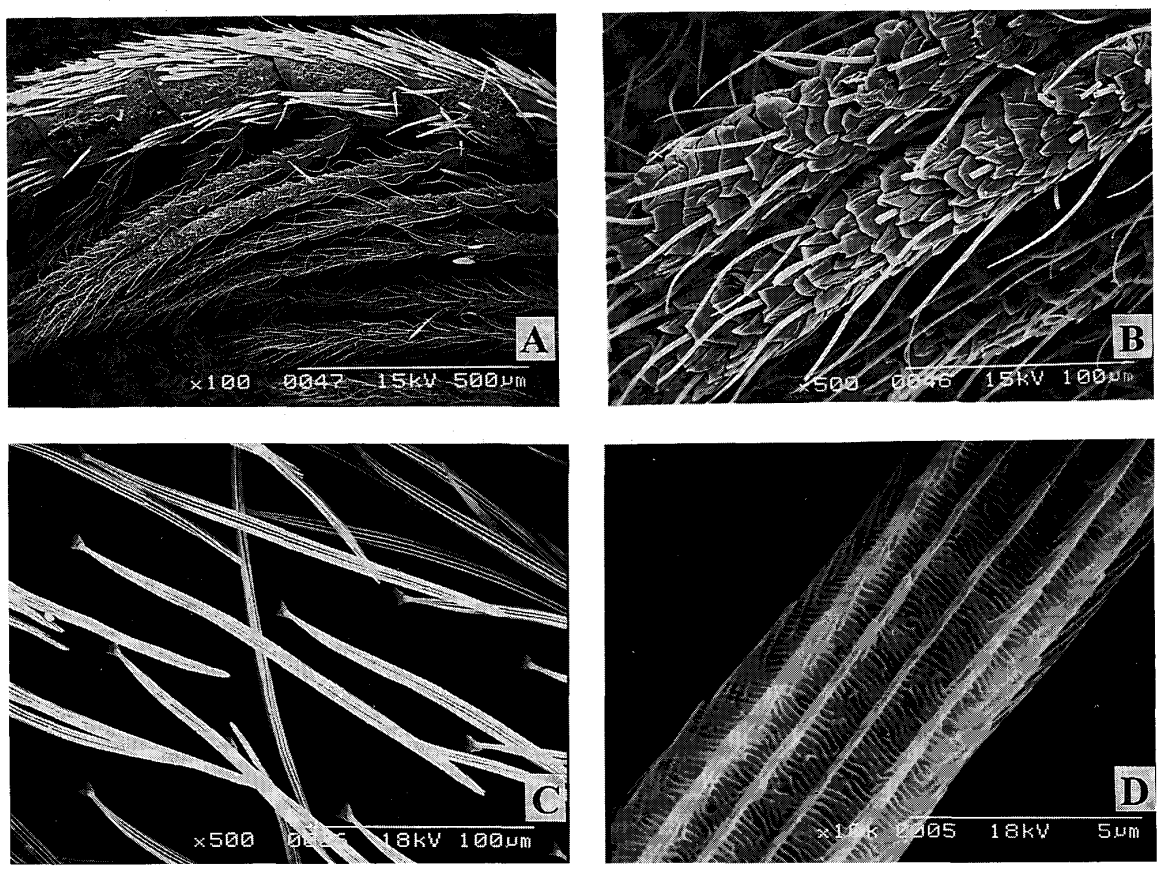

Fig. 2. Ultrastructure of adult male of *Pryeria sinica* Moore. A. Flagellars of antenna. B. Sensillae on flagellars. C. Scales. D. Surface of a scale.

equal length; D1 posterodorsad from XD1 on prothoracic segment and anterodorsal from D2 on pro-, meso- and metathoracic segments and abdominal segment 9. SD1 primary on thoracic and abdominal segments, SD2 longer than SD1 on pro- and mesothoracic segments; SD1 longer than SD2 on metathoracic and abdominal segments 8–10. L1 and L2 of approximately equal length, L3 situated with L1+L2 on prothoracic segment; L3 with L2 on meso- and metathoracic segments. SV1 longer than SV2; SV2 anterodorsad from SV1 on thoracic segments; SV1 and SV2 situated on ventral proleg on abdominal segments 3–6; SV3 absent.

Pupa. Body 8.0–10.0 mm in length, 4.0–4.5 mm in width of mesothorax, stout, dorsoventrally compressed, enclosed in a greyish white, flattened semi-spherical cocoon. Colouration similar to larva with dorsal, subdorsal, submedial and medial black stripes. Head: Frons rectangular; proboscis reduced to two lobes; antennae reaching abdominal segments 8–9. Thorax: Prothoracic spiracles concealed; metathoracic legs reaching abdominal segment 7; wing sheathes extending to the middle of abdominal segment 6. Abdomen: 10 segmented, spiracles present on segments 2–8; admincula on tergites not prominent; apex of segment 10 with cremaster consisting of two stout spinulae.

Specimens examined. 1 ♂, TAIWAN: Nantou, Jean-ai, Jean-ai, Song-gang, *ca* 1,800 m, 23. xii. 1995, S. H. Yen leg. (NMNS); 1 ♀, 21. xii. 1992, K. Horie leg. (KHCT); 3 ♂ 2 ♀, xii. 1996, S. H. Yen leg. (NMNS); 1 ♂, Taipin (present name, Hsinchu County, Taping, 200 m), ?. v. ?, T. Shiraki leg. (NTUIM); 40 mature larvae from *Celastrus punctatus*, Taiwan, Nantou, Jean-ai, Jean-ai, Song-gang, *ca* 1,800 m, 14. iv. 1996, S. H. Yen leg. (CMNC, KHCT,

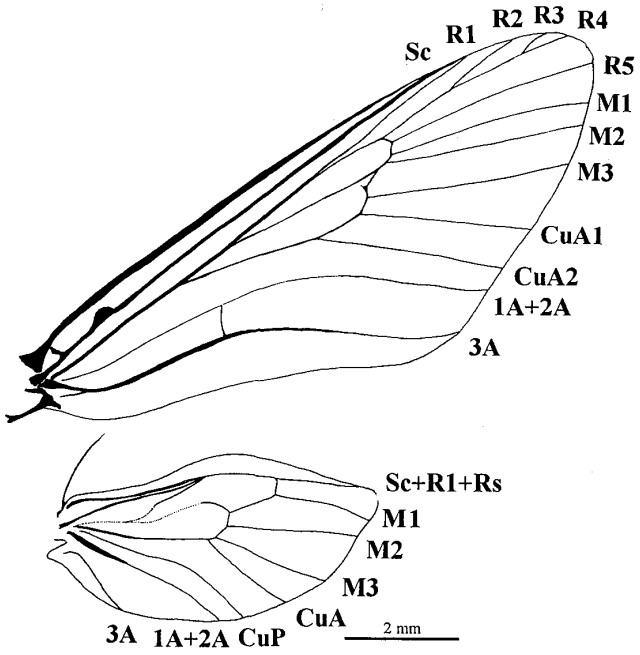

Fig. 3. Venation of *Pryeria sinica* Moore.

NSMT, NMNS, SHYC, TLFN, YKCT).

Additional specimens examined. 5 ♂ 5 ♀, China, Kiangsu, Shanghai, 11. xi. 1943, H. Höne leg. (ZFMK); 1 ♂ 1 ♀, Japan, Tokyo, Akatsuki-machi, Hachioji, 4. xi. 1986, K. Yazaki leg. (*ex* YKCT); Nagoya, 4. xii. 1988, K. Nishihara leg. (SHYC); 45 larvae, Campus of Kyoto Prefectural University, 18. x. 1995, *ex* eggs on *Euonymus sieboldianus*, S. H. Yen leg. (SHYC); 30 mature larvae on *Euonymus japonica*, Nagoya, 9. iv. 1996, K. Nishihara leg. (SHYC).

Taxonomic comments. Compared with the Japanese populations from Nagoya and Kyoto, the Taiwanese adult specimens are slightly smaller in size and darker in colouration, like the form named *Neopryeria jezoensis* Matsumura from Hokkaido, and the larvae have paler ground colouration and wider black stripes. In conventional taxonomy, it may be possibly proposed to be a new subspecies, however, our examination of a long series of specimens from China (Shanghai), Russia (Far-East), Korea and Japan reveals that infraspecific variation is continuous and subtle. This discovery is clearly an case of clinal variation between large populations in mainlands and relic in small mountainous island. Larval colouration is possibly a good and stable character to define different populations, therefore, at the moment any taxonomic treatment is not necessary unless all the larvae from the major distribution are available and have been compared.

Geographical distribution. Taiwan (subalpine zone). In Taiwan, this species is possibly scattered in several localities at high altitudes of the physiographic region Hsuehshan Range with abundant hostplant resource. The two specimens from the Shiraki Collection in NTUIM were probably collected at higher elevation near Bei-Pu but labelled as "Taipin", a locality with only 200 m altitude.

Habitat. The vegetation of the locality is temperate to cool-temperate and mainly composed of evergreen oak forests with heavy cloud cover and frequent fog. The stratification is

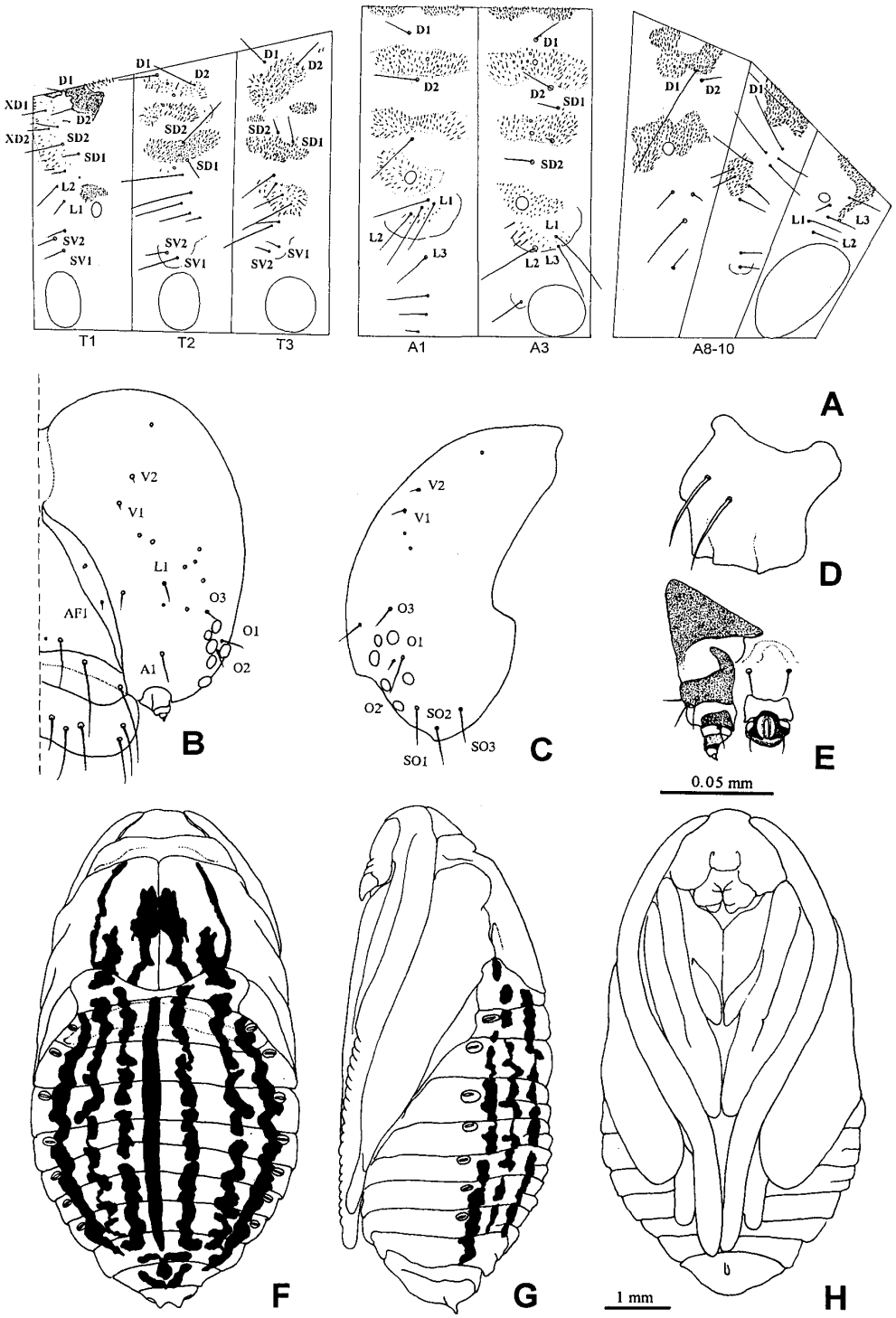

Fig. 4. Immature stages of *Pryeria sinica* Moore. A. Body chaetotaxy of mature larva. B. Head chaetotaxy of mature larva, frontal view. C. Ditto, lateral view. D. Right mandible, frontal view. E. Phary. F. Pupa, dorsal view. G. Ditto, lateral view. H. Ditto, ventral view.

characteristically three or four layers. The canopy and subcanopy species are composed of *Beilschmiedia erythrophloia, Castanopsis longicaudata, Quercus stenophylloides, Litsea acuminata, Machilus thunbergii, Acer kawakamii, Carpinus kawakamii, Rhododendron formosana*, and *Symplocus anomala*. The undergrowth of shrubs and undershrubs is

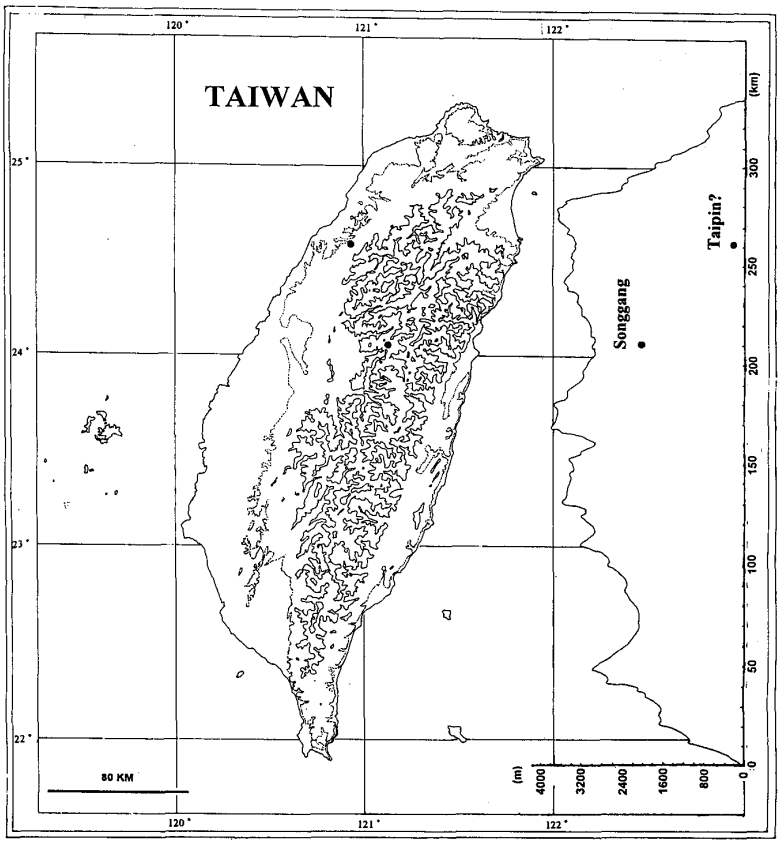

Fig. 5. Distribution of *Pryeria sinica* Moore in Taiwan.

formed by *Eurya acuminata, Vibrunum taiwanianum, Schisandra arisanensis* and *Rubus rolfei*.

Behaviours. According to our observation at Songgang in winter of 1995, the adults were diurnal with slow but wasp-like flying at about 1–5 m above the ground. The peak activity occured about 9 : 00 am to 3 : 00 pm. Adults usually copulated in the daytime and the copulation lasted for 20 hours. Eggs of *Pryeria sinica* are ovoid, flattened and covered with the hair tufts of female abdomen. Oviposition took place during the day and was completed generally within a few hours after copulation. The egg phase lasted for an avarage of 80 days under about 10–18°C. An obligate diapause took place in the pupal stage from May to November. The detail ethology of this species has been well studied and documented by many aothors (Ishii, Johki & Hidaka, 1983 ; Shiotsu & Arakawa, 1982 ; Shiotsu & Tsubaki, 1986 ; Tamura, 1981 ; Tamura & Ouchi, 1977 ; Tsubaki, 1981 ; Tsubaki & Shiotsu, 1982 ; Wipking & Naumann, 1992).

Hostplant selection. There are two genera of Celastraceae, *Celastrus* and *Euonymus*, reported as hostplants of *Pryeria sinica* from its whole distributional range. According to Lu & Yang (1993), there are 4 species of *Celastrus* and 10 species of *Euonymus* recognized from Taiwan. All the species of *Celastrus* in Taiwan are growing in the thickets from low to medium altitudes (300–2,500 m) except for the tropical species *C. paniculatus* Willd. Among them, the geographical distribution of the confirmed hostplant *C. punctatus* Thunb. also extends to S. China and Japan, which agrees to the range of *Pryeria sinica*. This plant is also the only member of the genus shared by the floras of Japan (including the Okinawa islands) and Taiwan. Such congruity reveals a reasonable interpretation of existance of this

insect in the subalpine zone of Taiwan. The genus *Euonymus* is diversed in Taiwan with 5 endemic species, 3 species also present in Japan (including Okinawa) and China, and 2 species shared by the SE. China and SE. Asia. In Taiwan, we have not confirmed any *Euonymus* species utilized by *Pryeria sinica* although the insect was suspected to only accept endemic alpine species such as *Euonymus morrisonensis* Kanehira & Sasaki, *E. spraguei* Hayata and *E. trichocarpus* Hayata plus a non-endemic species *E. oxyphyllus* Miq. However, the preliminary test of host replacement has shown that *E. spraguei* was not accepted by the mature larvae. The subtropical and tropical *E. carnosus* Hemsl., *E. cochinchinensis* Pierre, *E. japonicus* Thunb., *E. laxiflorus* Champ. *ex* Benth., *E. pallidifolia* Hayata and *E. tashiroi* Maxim are excluded from the host selection of this palaearctic insect. *E. japonicus* is very common in the lowlands of Japan, China, the Philippines, SW. and NE. Celebes, Java, Sumatra, and Malaysia, and is commonly utilized by *Pryeria sinica* in lowlands of Japan, however, this plant is only known from Orchid I. (Lanyu) and Green I. (Lutao), the tropical sea islands of Taiwan, therefore this plant is impossible to be selected by *Pryeria* in Taiwan.

In Japan, *Pryeria sinica* is a systematic oligophagous insect which utilizes both *Celastrus* L. and *Euonymus* L. (Celastraceae) as hostplants (Hattori, 1969; Sato, 1969; Inoue, 1982). However, in laboratory as we replaced *Celastrus* leaves with *Euonymus* as food for Taiwanese larvae, they refused to feed on it even never bite it. That means Taiwanese *Pryeria sinica* is first degree monophagous on *Celastrus punctatus*. We tent to discuss this interesting monophagous phenomenon with phenological observation and phytogeographical inference. Tsubaki and Shiotsu (1982) reported that the group feeding behaviour of *Pryeria sinica* larvae is a good strategy and provides potential to occupy the hostplant resource. However, things are not always in the same way. At the habitat of Taiwanese *Pryeria sinica*, the Celastraceae plant resource is also shared and competed by many grasshoppers and 10 species of the *Abraxas* geometrid moths, which are very dominant and multivoltine. During the period from December of the year to March of the next year, when *Pryeria sinica* overwinters in egg status, the larvae of *Abraxas* still keep on consuming the Celastraceae resource. While by the budding period of all Celastraceae species in March, nearly all *Abraxas* larvae have got ready to enter pupal stage or emerged from hibernating pupae, thus *Pryeria sinica* is tentatively capable to replaces the niche of *Abraxas* as defoliater on *Celastrus punctatus* during the short developmental stages from the middle March to the end of April. That is the phenological observations supporting monophagous behaviour of this insect in Taiwan. The other inference is based on phytogeographical coincidence. According to the above introduction to Celastraceae diversity of Taiwan, 3 endemic alpine species of *Euonymus* are potentially utilized by the palaearctic *Pryeria sinica*, but they are still refused by the larvae. Therefore, this indicates that monophagy of *Pryeria sinica* in Taiwan is not only caused by resource competition by other insects with the same niche but also by phytogeographical evidence which only the range of *Celastrus punctatus* matches that of *Pryeria sinica* in Taiwan (Hsuhshan Range), Japan and E. China.

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摘　　要

台湾産ミノウスバについて (顔　聖紘・堀江清史)

ミノウスバ, *Pryeria sinica*, は中国上海産の標本を基に記載され, これまで, 中国東部, 日本, 朝鮮半島, 極東ロシアに分布が知られていた. 筆者らは新たに台湾の山地 (標高 1,800 m) にも本種が分布することを発見した.

日本においては，成虫は晩秋に羽化し，食樹のマサキが生垣に使われることもあり，都市部においても昼間活発に飛びまわるのを観察することができるが，台湾においては成虫は12月末に発生している．また，4月に老熟幼虫をニシキギ科ツルウメモドキ属の *Celastrus punctatus* より採集している．成虫は，日本産と比較し，小型で色も黒く，一見して異なった印象を受ける．また，幼虫の色彩も地色が薄く，黒い帯が太いなど違いが見られる．このため別亜種として扱う可能性も検討したが，各産地の標本を比較すると変異は連続的で微妙であり，今後幼虫形態も含めて各地の標本を比較する必要があると考え，分類上の取り扱いについては従来通りとした．

臺灣產中國毛斑蛾 (斑蛾科：斑蛾亞科) (顏　聖紘・堀江清史)

近夾筆者於臺灣之亞高山帶發現了中國毛斑蛾 *Pryeria sinica* 之分布，本種並爲該亞科於臺灣之首次紀錄．本文提供該新記錄種之分類學描述，生殖器繪圖，生物學觀察與寄主植物選擇．此項發現並具生物地理學上之意義．

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